

MODEL #3 HDTV - EXTENSIVE LOCAL PLAYBACK CAPABILITIES

2	HD compressed format VTR's	\$80K/each	\$160K
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1	HD compressed format video cart machine	\$800/each	\$800K
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	HD router expansion		\$40K
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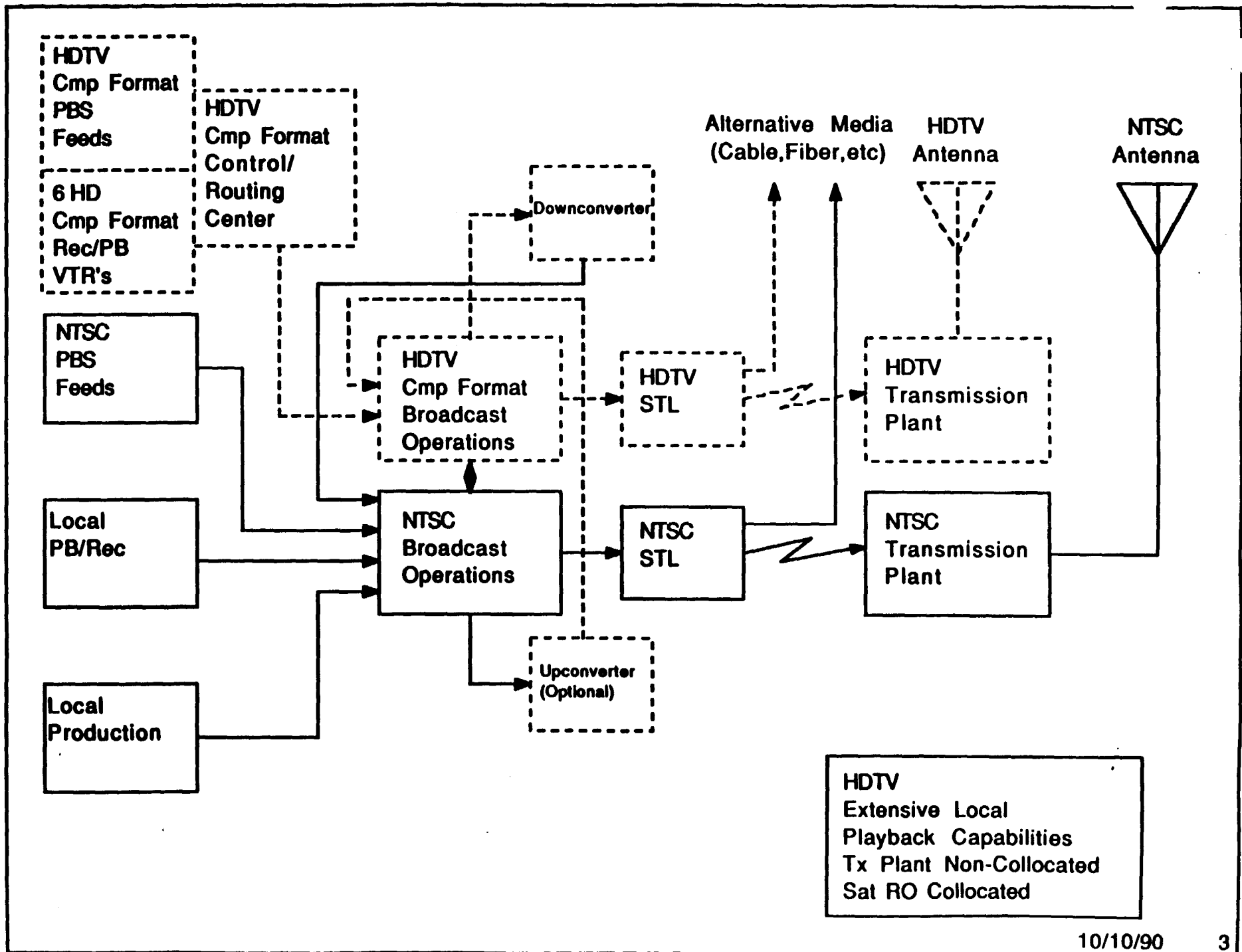
8	HD B&W monitors (8")	\$2K/each	\$16K
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	Subtotal		\$1,016K
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	Installation Materials (5%)		\$51K
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	Model 3 Total		\$1,067K
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	Total for Models 1, 2 and 3		\$2,343K
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MODEL #4 HDTV - PRODUCTION/POST/REMOTE CAPABILITIES

Broadcast Format Equipment (Compressed Format)

2	HD compressed format VTR's	\$80K/each	\$160K
	HD router expansion		\$40K
4	HD B&W Monitors (8" Dual)	\$2K/each	\$8K
1	HD STL (Add Redundancy)	\$48K/each	\$48K
			<hr/>
Distribution Subtotal			\$256K

MODEL #4 HDTV - continued

Production Format Equipment (Wideband Format)
(all of the following operates in a full bandwidth format)

Studio Production Equipment

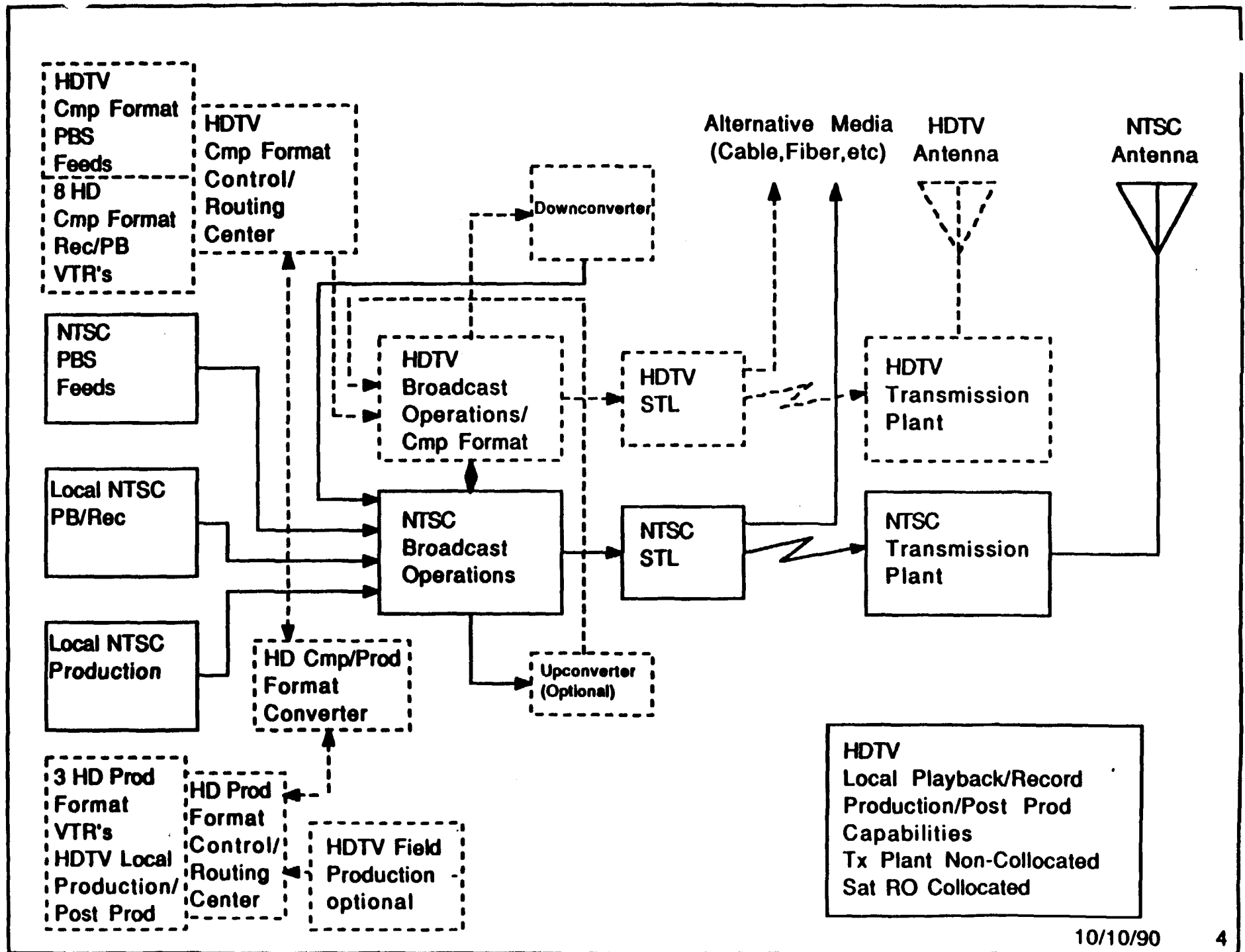
3	HD VTR's	\$320K/each	\$960K
1	HD routing switcher	\$160K/each	\$160K
3	HD cameras	\$375K/each	\$1125K
1	HD switcher	\$400K/each	\$400K
	HD signal distribution/processing		\$35K
1	HD DVE	\$250K/each	\$250K
	HD signal distribution		\$75K
1	HD compressed/Full Band Format Converter	\$50K/each	\$50K
1	HD character generator	\$120K/each	\$120K
	HD sync system/distribution		\$75K

MODEL #4 HDTV - continued

2	HD Color Monitors (28")	\$25K/each	\$50K
4	HD Color Monitors (18")	\$11K/each	\$44K
13	HD B&W Monitors (14")	\$3.7K/each	\$48K
8	HD B&W Monitors (8")	\$2K/each	\$16K
8	HD Utility WM's	\$6K/each	\$48K
1	HD Frame Synchronizer	\$38K/each	\$38K
	HD Test Equipment		\$100K
1	HD Precision WM	\$12K/each	\$12K
1	HD Precision Signal Monitor	\$20K/each	\$20K

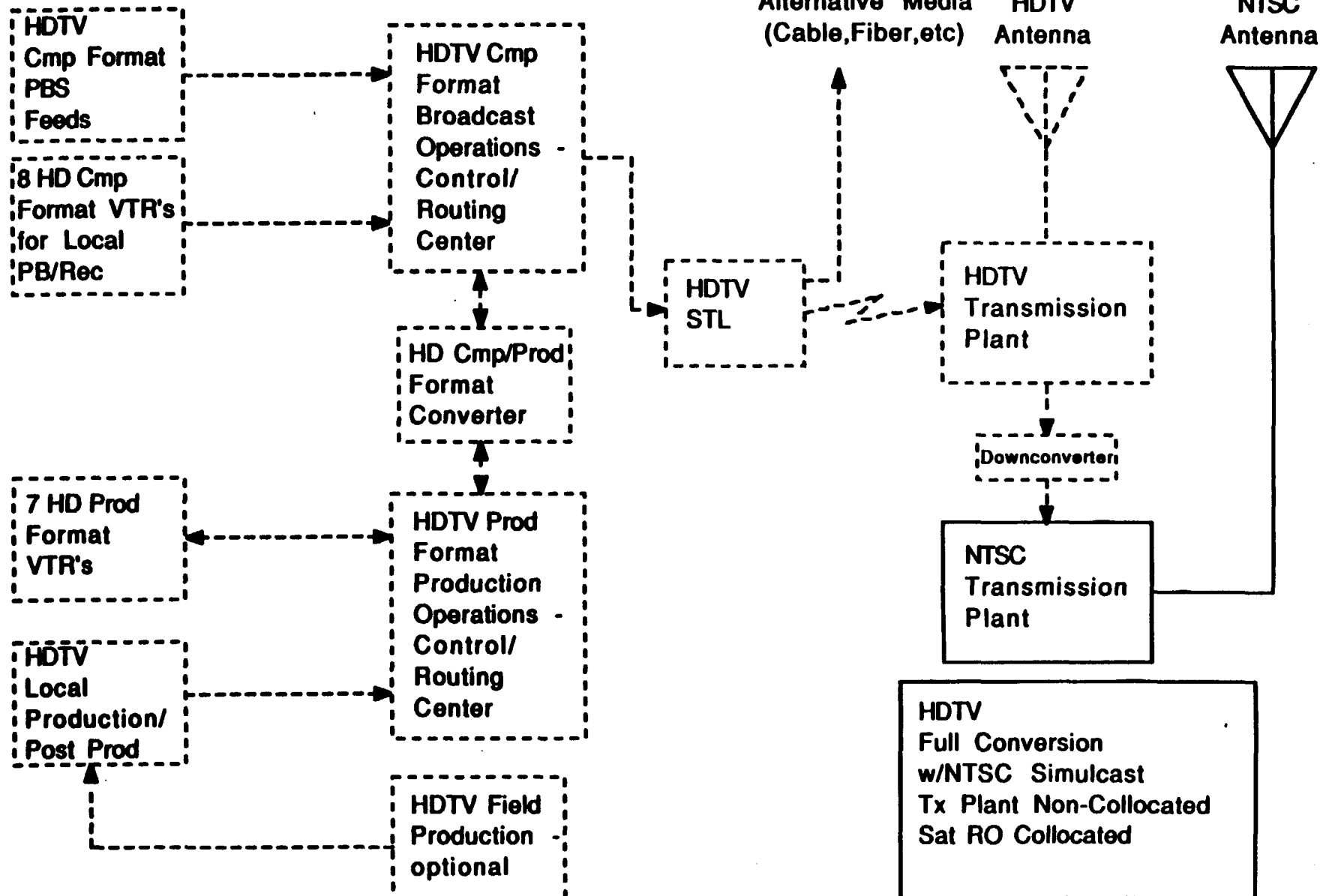
Field Production

1	HD field camera	\$375K/each	\$375K
1	HD field VTR	\$320K/each	\$320K



MODEL #5 HDTV - FULL CONVERSION

4	HD wideband VTR's	\$320K/each	\$1,280K
8	HD B&W monitors (8")	\$2K/each	\$16K
			<hr/>
Subtotal			\$1,296K
Installation Materials (5%)			\$65K
			<hr/>
Model 5 Total			\$1,361K
Total for Models 1, 2, 3, 4, & 5			\$9,776K



VII. Complete Station Packages

Pass-Through Network Programming

VHF Station, Low Band (best case)	
Transmission Package 1	\$936K
Broadcast Origination (Model 1)	\$770K
Total	<hr/> \$1.706M

VHF Station, Low Band (worst case)	
Transmission Package 2	\$3,484K
Broadcast Origination (Model 1)	\$770K
Total	<hr/> \$4.254M

VHF Station, High Band (best case)	
Transmission Package 3	\$986K
Broadcast Origination (Model 1)	\$770K
Total	<hr/> \$1.756M

VHF Station, High Band (worst case)	
Transmission Package 4	\$3,534K
Broadcast Origination (Model 1)	\$770K
Total	<hr/> \$4.304M

UHF Station (best case)	
Transmission Package 5	\$1,116K
Broadcast Origination (Model 1)	\$770K
Total	<hr/> \$1.886M

UHF Station (worst case)	
Transmission Package 6	\$3,664K
Broadcast Origination (Model 1)	\$770K
Total	<hr/> \$4.434M

Limited Playback

VHF Station, Low Band (best case)	
Transmission Package 1	\$936K
Broadcast Origination (Model 2)	\$1,276K
Total	<hr/> \$2.212M

VHF Station, Low Band (worst case)	
Transmission Package 2	\$3,484K
Broadcast Origination (Model 2)	\$1,276K
Total	<hr/> \$4.760M

VHF Station, High Band (best case)	
Transmission Package 3	\$986K
Broadcast Origination (Model 2)	\$1,276K
Total	<hr/> \$2.262M

VHF Station, High Band (worst case)	
Transmission Package 4	\$3,534K
Broadcast Origination (Model 2)	\$1,276K
Total	<hr/> \$4.810M

UHF Station (best case)	
Transmission Package 5	\$1,116K
Broadcast Origination (Model 2)	\$1,276K
Total	<hr/> \$2.392M

UHF Station (worst case)	
Transmission Package 6	\$3,664K
Broadcast Origination (Model 2)	\$1,276K
Total	<hr/> \$4.940M

Production

VHF Station, Low Band (best case)	
Transmission Package 1	\$936K
Broadcast Origination (Model 4)	\$8,566K
Total	<hr/> \$9.502M

VHF Station, Low Band (worst case)	
Transmission Package 2	\$3,484K
Broadcast Origination (Model 4)	\$8,566K
Total	<hr/> \$12.050M

VHF Station, High Band (best case)	
Transmission Package 3	\$986K
Broadcast Origination (Model 4)	\$8,566K
Total	<hr/> \$9.552M

VHF Station, High Band (worst case)	
Transmission Package 4	\$3,534K
Broadcast Origination (Model 4)	\$8,566K
Total	<hr/> \$12.100M

UHF Station (best case)	
Transmission Package 5	\$1,116K
Broadcast Origination (Model 4)	\$8,566K
Total	<hr/> \$9.682M

UHF Station (worst case)	
Transmission Package 6	\$3,664K
Broadcast Origination (Model 4)	\$8,566K
Total	<hr/> \$12.230M

TAG

FOURTH INTERIM REPORT
OF THE CHAIRMAN
OF THE
PLANNING SUBCOMMITTEE'S WORKING PARTY 6
ON SUBJECTIVE ASSESSMENTS
OF THE
FCC ADVISORY COMMITTEE ON
ADVANCED TELEVISION SERVICE

Craig K. Tanner
Chairman

Bronwen L. Jones
Vice Chairman

March 19, 1991

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- Letter from Chairman R. Wiley re use of Sony Camera
- Letter from David Sarnoff Research Ctr. re Transconversion
- Report of the Ad Hoc Group on Production Planning
- PS/WP-6 Document List

I. EXECUTIVE SUMMARY

This is the fourth interim report of Working Party 6 on Subjective Assessments. During this period, the efforts of the Working Party were centered on one primary task -- that of producing the high definition and NTSC test materials, both motion and still, needed for conduct of the FCC Advisory Committee's subjective test plans. This report will focus primarily on this activity, although the Working Party's other activities will also be reported.

Working Party 6 held seven meetings during the period, as follows: April 11, May 10, May 25, July 11, September 14, and November 8, 1990; and Jan. 24, 1991.

The Working Party's Ad Hoc Group on Production Planning, chaired by NBC's Alan Godber, held eight meetings. A Camera Test Subgroup, with Hank Mahler of CBS as test manager, met three times formally, and many times during actual lab testing of the high definition cameras. Finally, a Film Transfer Task Force chaired by Carl Eilers of Zenith Electronics Corporation met twice via telephone. Jim Gaspar of Panasonic acted as Chairman of the Ad Hoc Group on Production Support, which held no meetings, but which organized the technical aspects of the production of the video-based test materials. The Working Party's Ad Hoc Group on Still Test Material, chaired by Bronwen Jones, held several meetings with NASA and Kodak, and in September, successfully delivered to the Advanced Television Test Center the digital data tapes of the still test images.

As of the date of this report, the Working Party has successfully completed production of the studio portion of the test materials, although some post-production editing is required before delivery to the Advanced Television Test Center and Cable Television Laboratories. It is expected that this material will be edited and ready for final delivery by March 22, 1991.

The Working Party has also successfully recorded the raw

footage for the so-called "proponent" material. These are the ten 2-minute scenes intended for delivery to each of the ATV system proponents (not including Zenith or MIT, who did not participate in this phase of the production). This material is for the laboratory use of the ATV system proponents in preparing their systems for test. At the time of this writing, the post-production editing of this proponent material still remains to be performed. The material shot consists of exterior scenes of New York City in the necessary high definition formats. It is intended to provide a wide range of material for proponents' system testing, without duplicating, or thereby compromising, the integrity of the official subjective test material.

Finally, the Working Party, as part of the production of the studio-based video material, and with the cooperation of the Advanced Television Test Center, recorded in all five formats the mechanically-rotated dynamic resolution patterns needed for objective testing of the proposed ATV systems.

Remaining on the Working Party's work schedule in the coming weeks are the final verification of the technical performance of the multi-format telecine system being built under contract to Zenith Electronics Corporation by Showscan Film Corporation and with the assistance of BTS, Inc. When this system is verified as having satisfactory technical performance, the four film segments, each 10 seconds in length, will be transferred to the four high definition video formats and to NTSC. These will include two scenes at 24 frames per second, one scene at 30 frames per second, and one 70mm scene at 60 frames per second.

Finally, the Working Party must complete the computer-based rendering of a single 10-second motion sequence and a single still image, and transfer the resultant digital image data to the four high definition video formats and to NTSC. AT&T Bell Laboratories is completing a final, detailed technical proposal describing this work, and PS/WP-6 expects to be able to give a go-ahead for the rendering work to begin at Bell Labs. Conversion of the master rendered image to the five required formats and the final recording of these images is

expected to be completed by April 3, 1991.

While there remains some substantial work ahead, it is appropriate here to recognize the valuable contributions by the ATV system proponent organizations, the test laboratories and the broadcasters who made cash contributions to the production of the test materials; to thank the many companies who loaned valuable equipment to the effort, and to express gratitude to those who volunteered their expertise and in some cases, many, many weeks of labor away from their normal job responsibilities to make the technical complement of equipment work successfully.

Deserving of special commendation are Jim Gaspar of the Panasonic Advanced Television & Video Laboratory, who served as Technical Coordinator for the studio and exterior productions; and Paul Hearty of the Advanced Television Evaluation Laboratory in Ottawa, Canada, who served as Content Coordinator for the studio-based scenes. Thanks also to Alan Godber and Jay Ballard of NBC, who contributed substantial time and expertise. All those working on this project did so under conditions of extreme time and cost pressure. They successfully resolved many technical challenges never before met in any video production. Credit is also due Phil Crosby of Tektronix Corporation, for his work in interfacing the Tektronix Format Converter to the Sony digital high definition video tape recorders at the production site to allow digital recording of the high definition video signals.

Deserving of special recognition is NHK, who designed and built the HDTV Transconverter which will be used to derive some of the subjective test materials from camera-originals in the 1125/60/2:1 format.

Recognition is also due to David Niles and the staff of his company, Captain of America, the New York-based high definition production company which was contracted by the Working Party to handle the creative aspects of the production.

II. STATEMENT OF WORK FOR THE FOURTH PERIOD OF WORK

The March, 1990 Third Interim Report of the Planning Subcommittee of the FCC Advisory Committee on Advanced Television Service set forth the following statement of further work for the Working Party on Subjective Assessments:

"PS/WP-6 has several major assignments it intends to complete in the near future. The first is to revise and approve the still test material. The second task is to ensure that the source material demonstration is conducted, and, following a decision as to the manner in which the material will be produced, to conclude production of the dynamic source material and have it ready for testing no later than September 1, 1990. Finally, PS/WP-6 expects to examine both the telecine system to be used for transferring the 35mm/24 fps film images to video tape and the high definition television cameras used in the production of motion sequence test material to ensure that the resulting image quality of these devices is state-of-the-art."

III. STATEMENTS OF PROGRESS

A. FUNDING STATUS FOR SUBJECTIVE TEST MATERIALS

Following is a statement of the funds contributed by various parties for the production of the subjective test materials:

Cable Television Laboratories, Inc.	\$100,000
David Sarnoff Research Center	60,000
General Instrument Corporation	60,000
Massachusetts Institute of Technology	60,000
NHK (Japan Broadcasting Corporation)	60,000
Philips Consumer Electronics	60,000

(cont'd. next page)

(continued)

Zenith Electronics Corporation	60,000
Advanced Television Test Center, Inc.	50,000
CBS Inc.	30,000
Capital Cities/ABC Inc.	<u>20,000</u>

TOTAL FUNDS CONTRIBUTED	\$560,000
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As of the date of this report, final expense totals against these collected funds are not available, but the Chairman of the Working Party believes the funds will be nearly fully expended, as planned. A final statement will be issued by the Chairman within the next few months, when the production of the complete set of subjective test materials is completed.

B. VIDEO-ORIGINATED MOTION TEST MATERIALS

TEST SEQUENCES PRODUCED

The following motion (or "dynamic") test sequences have been recorded and will be delivered to the Advanced Television Test Center and to Cable Television Laboratories:

Format indications at column headings
are as follows: 1125 indicates 1125/60/2:1
1050 indicates 1050/59.94/2:1
525-P indicates 525/59.94/1:1
787-P indicates 787-788/59.94/1:1.

Basic Quality Test Sequences

	<u>1125</u>	<u>1050</u>	<u>525-P</u>	<u>787-P</u>	<u>NTSC</u>
1. Window	x	x	x	x	x
2. Fax Machine	x	x	x	x	x
3. Paint Store	x	x	x	x	x
4. Mannequins	x	x	x	x	x
5. Living Room	x	x	xx	x	x
6. Den	x	x	xx	x	x
7. Park Ride	x	x	x	x	x
8. Bubbles	x	x	x	x	x
9. Audience	x	x	xx	x	x
10. Woman & Room	x	x	x	x	x

Note that those marked with an "xx" in the 525-P column are scenes that were not produced directly via use of a camera operating in the 525-progressive scanning format. As the production work progressed, it became clear that time and budgetary constraints would preclude the original camera recording of all scenes in all formats. Through prior agreement with the David Sarnoff Research Center (the proponent whose system will be tested with 525-progressive materials), the Working Party's on-site production team selected to bypass production of scenes 5, 6 and 9 on the stage, in order to be sure of delivering a complete set of test materials. The 525-progressive version of scenes 5, 6 and 9 will be derived via digital scan-conversion from the recorded 1125/60 material through use of the NHK-designed high definition transcoder.

Impairment Test Sequences

	<u>1125</u>	<u>1050</u>	<u>525-P</u>	<u>787-P</u>	<u>NTSC</u>
11. Lamp	x	x	x	x	--
12. Times Square	x	x	x	x	--
13. Co-Channel	x	x	x	x	--
14. Interferor	To be created in post-production.				

Note that scenes 11, 12 and 13 are marked with a "--" in the NTSC column, indicating that NTSC versions of these scenes were not produced. They are not needed, according to the Advisory Committee's ATV test plans.

DETERMINATION OF PRODUCTION TECHNIQUE

The March 1990 statement of work for PS/WP-6 directed that the Working Party conduct a feasibility demonstration of the two possible procedures for production of the motion test materials in the four necessary high definition formats. These possible procedures were as follows:

1. High definition video materials could be imaged in four distinct scanning formats by a camera (or cameras) actually operating in the required formats: 525-progressive, 787-progressive, 1050-interlace, and 1125-interlace formats.

The sequences would be recorded in serial fashion as opposed to in a parallel, or simultaneous fashion, to avoid parallax (angle of view) errors. Camera movement would be automated, and scene action would be repeated.

2. The full set of high definition video materials would be provided through use of only two cameras -- an 1125-interlace camera and a 787.5-progressive camera. The other two formats would be derived via standards conversion through use of the NHK-designed high definition transcoder.

Early in the working period, Working Party opinion was split regarding which of these techniques was preferable. Some were concerned about the ability of the first technique to provide suitably matched picture content, and about the difficulty and time that would be consumed in producing each scene five times (including NTSC).

Others were concerned about deriving test materials via transconversion with the NHK device. Some felt that such test material would already have been digitally processed in ways that would render its quality level lower than that which could be provided directly by a camera operating in the necessary format. The same group felt that transconverted test scenes might involve subtle differences which, while perhaps not immediately visible, could cause visible artifacts when concatenated with the compression algorithms contained in the some of the proponents' ATV systems.

The Working Party decided to perform a series of objective tests on the NHK transconverter to determine its suitability for use. A subjective examination of the transconverter's performance on July 11 had resulted in split opinions over the significance of artifacts in the transconverted pictures.

At the Working Party's September 14 meeting, the results of the transconverter tests were presented. Opinions again were split, although two of the proponent organizations that would be the recipients of any transconverted materials, North American Philips and the David Sarnoff Research Center, presented technical evidence to support their objections to

use of the device.

Final agreements reached at that meeting, as reflected in the minutes, were as follows:

The transconverted 1050/59.94/2:1 recorded signal is the preferred input for all image sequences for the General Instrument System (per GI's preference). [In the Working Party's meeting of November 8, it was further agreed that any proponent should have the option of using the transconverted materials rather than camera-originated materials].

A camera-originated recorded signal will be used for input to the Philips 1050/59.94/2:1 system (per Philips' preference).

The transconverted 525/59.94/1:1 signal recorded signal will be examined on a case by case basis at the time of production. Camera original recordings for 525/59.94/1:1 will only be made for image sequences for which the transconverted signal is deemed unacceptable by the David Sarnoff Research Center. [This flexibility on the part of the Sarnoff Center was ultimately taken advantage of for the production of three sequences, as noted on pages 7 & 8 of section III B., under the heading TEST SEQUENCES PRODUCED].

In summary then, it was decided to proceed with the production of the video-based motion test materials by attempting to shoot with cameras operating in each scanning format, subject to the time and/or budget pressure to transconvert some to 525-progressive.

HDTV CAMERA PERFORMANCE ISSUES

During the working period, there was considerable controversy over the proposed use of the Sony HDC-300 high definition video camera (instead of the BTS KCH-1000 camera) for generation of the required 1125/60/2:1 images. After much discussion, it was agreed by the Working Party in its